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XLVIII. *A Letter from William Brownrigg, M. D. F. R. S. to Sir John Pringle, Bart. P. R. S. relating to some Specimens of native Salts, collected by Dr. Brownrigg, and shewn at a Meeting of the Royal Society, June 23, 1774*.*

SIR,

Redde, June 23, 1774. **I** BEG leave, through your hands, to convey to the Royal Society, specimens of various salts, which I have found native in the coal-mines near Whitehaven; and which, I flatter myself, may be of some use in assisting us to form a right judgement concerning the generation of these salts, and the various ingredients that enter their composition.

The first of those native salts which I offer to the Royal Society, is the *sal catharticus amarus*, or the *bitter salt*; which, though it was only first discovered by Dr. GREW in the Epsom waters so lately as towards the close of the last century, is found in more abundance, and more universally diffused over this globe than any other salt, the common salt

* These specimens were afterwards deposited in the British Museum. S. HORSLEY.

excepted. The waters of the ocean are known to be strongly impregnated with this salt, and from it to acquire their bitter taste. It has also been discovered in many springs, in almost all known parts of the world; many of which are thereby rendered unfit for domestic uses, though highly serviceable in medicine. Many lakes contain large quantities of this salt; as the lake Asphaltus, and some of the lakes in Siberia^(a): and lastly, it will appear from the specimens of this salt here produced, that it continually germinates from stones, and other substances lodged in the bowels of the earth; from which subterraneous stores, not only the springs and lakes, but also the ocean itself seems, in part at least, to be supplied with it.

In Partition N° 1. are various specimens of this bitter salt, which I found germinating, in great abundance, from a whitish-grey free stone, in many parts of the colliery of Howgill near Whitehaven. It there grows, or shoots out from this stone, in very fine and tender filaments, which are white and shine like polished silver. These filaments are of various lengths: some I have seen three inches long; and they are often set so close to each other as to adhere together into one mass. They are often very pure, but sometimes are intermixed with minute efflorescences of green vitriol; which salt also germinates in great abundance in the same colliery. The green vitriol, which is extracted from the martial pyrites found among the coal in the same mine, has also sometimes mixed with it a small portion of this bitter salt, as I learned from experience, having

(a) Gmelin.

frequently

frequently taken large quadrilateral crystals of this last mentioned salt out of the cisterns in which a strong *lixivium* of green vitriol had been set to crystallize at the copperas works near Whitehaven.

And here it may be proper to remark, that the large beds of freestone found in the coal-grounds near Whitehaven, and in most other places where there are veins of coal, though such stone is often very hard when dug out, and does not seem liable to decay while lodged deep in the earth, yet will seldom endure the weather; but, when exposed to the open air, gradually moulders into dust, and is therefore unfit for buildings. Which decay of these stones seems owing chiefly to the germination of this bitter salt, and sometimes also to that of vitriol; but seldom to the formation of nitrous salts, as has been most commonly supposed.

Partition II. N° 2. Bitter salt, from the same colliery, in a concreted form, found lying in small vacuities towards the top of some large pillars of coal, there left about forty years ago, to support the roof of the mine. The salt has been generated from the whitish grey freestone, of which this roof is formed, and seems composed of many small filaments (the same as N° 1.), that have gradually shot out from their stony *matrix* so close to each other, as to unite into one solid mass.

N. B. Various other kinds of salts, formed by germination, assume this fibrous texture, in like manner with this bitter salt, as will appear from the specimens of green vitriol and alum here exhibited, which I collected from the same colliery of Howgill.

Partition III. N^o 3. The same bitter salt concreted into small solid and transparent masses, of an irregular form, in which state it is found in great quantities, in many parts of the collieries of Howgill and Whingill, near Whitehaven, in old works which have been deserted fourscore or a hundred years. Specimens of the native bitter salt, in this form, I sent to Sir Hans Sloane thirty years ago.

Partition III. N^o 4. (a) The native bitter salt (N^o 3.) depurated by solution in water, and decantation of the clear *lixivium* from the coal and other heterogeneous substances that had subsided therein; which clear *lixivium*, after having been brought to a due strength by coction, and then set in proper vessels, gave crystals, of which these here exhibited are a specimen.

Partition III. N^o 4. (b), Specimen of the same depurated salt, formed into somewhat larger crystals, in repeating the foregoing process.

The figure of these crystals is that of a quadrilateral column terminating, at the summit, in a quadrilateral pyramid. At the base they usually appear broken off from the vessel or other body to which they adhered during their formation. The four plain sides of the columns meet always at right angles, and in the slender crystals that first shoot, are of equal dimensions; but in the larger crystals (which seem compounded of smaller ones) two of the sides, that are opposite to each other, are often greater than the two other sides. The four triangles, that arise from the four sides of the column, most commonly differ from each other in form and in magnitude, and therefore compose irregular pyramids; and sometimes these crystals, instead of ending at a

point, terminate in a ridge formed by two inclined planes, which arise from the opposite and parallel sides of the column.

These crystals are perfectly clear, and of a fine deep water, and may be preserved in this state many years, by wrapping them up loosely in paper so as to keep them from being fullied by dust and other impurities. In this manner the crystals now presented to the Royal Society have been kept twenty years; and in all that time have not parted with any of the water of their crystallization so as to turn white and powdery; neither have they deliquesced by attracting the moisture of the air. Indeed none of the salts, formed by germination, that I have seen are subject to dissolve in a moist air; on the contrary, the salts, so produced, shoot most vigorously in a close and moist air; a certain portion of moisture being required in their formation. Some part however of this moisture several of those salts readily loose when exposed for a considerable time to the open air. The *Aphronitrum* or *sal murarius* (which is a fixed *alkali*) afforded me an instance of this kind. For, having depurated a considerable quantity of this salt, and reduced it into *rhomboidal crystals* of a very regular form; on examining these crystals, after I had kept them ten or twelve years in a phial that was corked, though not with great exactness, I then found them dry, and in part reduced to powder so as to have lost their transparency, and in a good measure their proper figure. The green vitriol is also apt to grow rusty, and to lose some of its water in the open air, though its acid, when pure, attracts moisture more greedily than, perhaps, any other saline body.

The

The native bitter salt of the coal-mines, purified as before related, I have found exactly to agree in the form of its crystals, as also in its cool bitter taste, its purgative quality, and other properties, with that salt which is commonly sold in the shops, under the name of Epsom salt, when this last named salt had been sufficiently purified and reduced into larger crystals. This native bitter salt also agrees, in all its qualities, with a salt (which I extracted from the thick and ponderous liquor known by the name of bittern) that remains in the salt-pans after the common salt is separated from sea water by coction. It is also the same with the salt of the Scarborough waters, as described by Dr. SHAW, which is sold at a great price under the name of Scarborough salt. Most of the other purging salts, sold under the names of the several waters from which they are extracted, seem to be the same with this bitter salt; but differ as they are formed into greater or smaller crystals, or according to their purity; there being many purging waters which, besides this bitter salt, hold common salt, the muriatic calcarious salt, natron, and other kinds of salt.

Of the several kinds of bitter salt abovementioned I have selected a few specimens from those which I have in my possession.

Partition IV. N^o 5. The common Epsom salts of the shops, purified in the following manner. The Epsom salt was dissolved in water, and the *lixivium*, after standing some time, was depurated from a large black scum which arose to its top, and from a dirty sediment; it was then, by gentle coction, freed from

from a large quantity of common salt, part of which arose to the top of the *lixivium* in small grains, and was thence skimmed off, and part of it subsided therein in larger grains. The *lixivium*, when thus purified, and reduced to a proper strength by gentle boiling, was suffered to shoot into small crystals in proper vessels, and the liquor that remained (which was a solution of the same salt, mixed with a considerable quantity of the muriatic calcarious and some common salt) was poured from it.

N° 6. Large crystals of depurated Epsom salt, which shot out from a fully saturated solution of this salt (N° 5.) made by pouring boiling water thereon, and suffering it to stand till cold.

N° 7. More regular crystals of the same salt.

N° 8. Bitter salt well purified, which I extracted from the marine bittern of the Salterns near Whitehaven, in which common salt is separated from sea water by coction.

The bitter salt, purified in this manner, is an excellent remedy in many diseases, and may be prepared at the British Salterns, for foreign as well as for home consumption, so as to be afforded at a very moderate price, I therefore heartily recommend it to be kept in the shops in this purified state, instead of the common Epsom salt now every where sold; which last, on account of its great impurities, is deservedly grown into disrepute.

N° 9. A salt which I extracted from the same marine bittern (N° 8.). Its crystals are very singular, being of a rhomboid and cuneiform shape, and are very consistent in common air. Their taste seems more bitter than that of the common bitter salt.

N° 10.

N° 10. Smaller crystals of the same salt with N° 9. These are, most of them, of a rhomboidal figure.

N° 11. Salt of the Scarborough water, which I purchased, about twenty years ago, from an apothecary of that place, who there prepared considerable quantities of it for sale. It does not differ from the purified Epsom salt (N° 7.), and that bitter salt which I extracted from the marine bittern (N° 8.)

N° 12. Several specimens of native green vitriol, from the coal-mines near Whitehaven. I found this vitriol in the colliery of Howgill, lying in great plenty in the joints or openings of the pillars of coal that had been left to support the roof of the mine, and in a part of it from whence the coal had been dug away about forty years ago. The vitriol is found in places to which the air seems to have had free access, and the coal near it commonly appears in a loose and crumbling state.

N°. 13. A curious specimen of the same green vitriol with the foregoing (N° 12.) which may serve to explain how it happens that the various specimens of this native salt, and of several other salts here exhibited, assume a fibrous appearance. The saline germinations in this specimen shoot out, or grow, from the pyrites, pretty close to each other, and in several places are united together into *fasciculi* or clusters; but in other places there are many openings, or vacuities, which, had it remained in its native situation, would, most probably, have been filled up by other filaments arising from its *matrix*, and the whole

whole saline concrete would have been reduced into one compact body, of a fibrous texture.

N° 14. Several specimens of the same green vitriol, which are more close and compact than the foregoing specimens (N° 13.); and in which the fibrous texture of the salt, thus generated by germination, is more apparent than in the specimens (N° 12.)

N° 15. Green vitriol germinating from martial pyrites.

N° 16. Sundry specimens of pyrites, with green vitriol adhering thereto, or lodged in its crevices, where the salts swelling, or continually increasing in bulk, act as wedges, and moulder the pyrites into powder. The pyrites, in this decayed state, appears black, from its bituminous and earthy parts remaining after its saline principles have been separated from it. Though in the specimens here exhibited, some fossil coal may have been intermixed with the pyrites. The miners have called this decaying of the sulphurous ores of copper, iron, and other metals and semi-metals, the *weathering* of these ores, having observed that this change or decomposition of these ores is brought about by the operations of common air, and of the watery moisture to which they have been exposed. For the *pyritæ* and other sulphureous ores remain without change in the bowels of the earth, while lodged in places, where neither the air nor water can act upon them.

N° 17. Native alum from the coal-mines near Whitehaven. In these specimens the alum is found adhering to the stone, from which it shoots out, in

very small white and shining filaments, which have a flocculent or downy appearance, and is therefore the same salt which was heretofore known under the name of *alumen plumosum*. Some kinds of *asbestos*, from their resemblance to this salt, have also, though very improperly, obtained the name of *alumen plumosum*. This salt has the distinguishing taste of alum, though somewhat more harsh and rough, owing either to some small mixture of vitriol of iron, which seems to shoot out along with the alum; or else, because most of the alum prepared for sale has urine, kelp, and other mixtures, added to the *lixivium* during its coction, which may render the salt so prepared less harsh and styptic than the native alum. The stone on which the native alum, here exhibited, germinates is black and shining, and has so much *bitumen* mixed with it, that it burns slowly, and leaves a white ash, when set on fire in large heaps. N. B. From the top of these heaps, I have collected considerable quantities of brimstone that was sublimed from this bituminous stone, while burning in this slow manner.

N° 18. Large pieces of the same native alum, very pure; on the outside it has got a yellowish cast by being exposed two years to the open air since it was taken from the mine; when broken, it appears on the inside more shining, and has a blueish cast.

N° 19. An earth found in considerable quantities near the above specimens of alum. From its extremely harsh, rough, and styptic taste, like that of burnt alum, it seems to be an aluminous earth. It

may also contain some small mixture of ochery earth, which may give it its yellow cast.

N° 20. A shining kind of stony clay, called by the miners *fill*, lying in large beds in coal grounds, it strongly resists the fire, and some of it, by germination, yields alum.

W. BROWNRIGG.

ERRATUM